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Impacts of Rural–Urban Labour Transfer and Land Transfer on Land Efficiency in China: A Analysis of Mediating Effects

Siyi Pei [1], Sudan Zhao [2,3,*], Xuan Li [4] and Jiahui Li [5]

[1] School of Marxism, South China University of Technology, Guangzhou 510641, China
[2] School of Marxism, Sichuan University, Chengdu 610065, China
[3] Institute of Land Economics and Management, School of Public Administration, Sichuan University, Chengdu 610207, China
[4] School of Economics, Sichuan University, Chengdu 610065, China
[5] Institute of Criminology, University of Cambridge, Cambridge CB3 9DA, UK
* Correspondence: sdzhao@scu.edu.cn; Tel.: +86-13540712710

Abstract: In the midst of China's ongoing rural–urban integration and development, a pivotal transformation involving the realignment of labour dynamics and land utilisation is underway. This paradigm shift has substantial implications for rural land use and agricultural productivity. Drawing from the field survey conducted in Zhejiang Province in 2019, this study puts non-agricultural employment, land transfer, and land efficiency into one econometric model and establishes a comprehensive framework to explain the mechanisms. Unlike existing research, this paper delves into the impact of different land-transfer behaviours, namely inflow and outflow, on land efficiency. The findings indicate that non-agricultural employment has no significant impact on land efficiency. Rural households acquiring land significantly enhance land efficiency, whereas relinquishing land shows no significance, thus addressing the gap in existing literature regarding the study of different transfer behaviours. Furthermore, to explore the underlying mechanisms, we investigate the mediating effect of land inflows on land efficiency, finding that it operates through plot size. In light of this, we propose that, in guiding land inflows, more emphasis should be placed on the integration and reorganisation of fragmented land rather than simply expanding the total land area, aiming to create large, well-managed areas of arable land by achieving concentrated and contiguous transferable land parcels.

Keywords: land transfer; mediating effect; land efficiency; heterogeneity

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1. Introduction

In the late 1970s, China initiated the implementation of the household rural system (HRS), which aims at enhancing farmers' motivation, has yielded significant results. Nevertheless, critical issues, including land fragmentation and irrational land use, have surfaced as the reform evolves and the situation changes. Consequently, the land efficiency and agricultural productivity face declining challenges. At the same time, the rapid urbanisation which accelerates China's rural hollowing worsened the situation. Developing countries like Ethiopia share similar situations and perceptions with China, particularly rural–urban labour transfer. Ethiopia and China have experienced significant rural–urban migration due to economic pressures and land-management issues, although the specific historical and policy contexts differ. For example, China's economic reforms and rapid urbanisation have led to a massive rural labour movement to urban centres, driven by industrialisation and the search for better living standards. In Ethiopia, similar migration patterns have been observed, though often within different policy frameworks and economic contexts, such as the need for agricultural reforms and addressing landlessness (Central Statistical Authority, 2003 [1]; Zewdu and Malek, 2010 [2]). It is noteworthy that the migration of rural labour to urban areas and non-agricultural employment has brought opportunities for the transfer of

rural land, with the area of land-use rights transfers reaching approximately 532 million mu (equivalent to about 35 million hectares) in 2022 (Xu et al., 2022) [3] in China. Land transfer is expected to significantly impact agricultural production methods and land-use efficiency, while the mechanisms explaining this process remain a subject of debate and controversy in the academic community. Therefore, there is an urgent need for further research and analysis to uncover the complex dynamics of this crucial aspect of rural development.

2. Literature Review

Numerous studies have investigated the intricate relationship between non-agricultural employment and regional development. A prevailing perspective, characterised by optimism, asserts that rural–urban migration catalyses local development. This assertion is primarily based on the premise that migrant workers contribute to local economies through remittances, which are seen as sources of enhanced productive investments, ultimately fostering economic development within these rural areas. Furthermore, this positive perspective highlights the transfer of expertise and the introduction of technological advancements by returning migrants as additional drivers of local economic progress (Penninx, 1982) [4]. Complementing this view, Wang et al. (2020) [5] utilised data from the Chinese Household Income Project 2013 to analyse how non-agricultural employment impacts rural land circulation in China. Their findings indicate that stability in non-agricultural employment, primarily through non-agricultural assets, significantly influences land-transfer decisions, with notable variations between China's Central and Western regions. This suggests a nuanced need for region-specific policies to promote efficient land use and support rural economic development.

Conversely, a more pessimistic viewpoint suggests that migration exacerbates labour shortages in rural villages, triggering adverse social and cultural consequences within these communities. Furthermore, this perspective argues that remittances often serve as short-term coping mechanisms rather than as investments in agricultural production. Instead, these financial resources are frequently allocated towards immediate consumption needs such as constructing new houses, supporting elderly family members, and covering educational expenses. Empirical evidence from Ethiopia and Nepal indicates that out-migration has led to shifts towards less labour-intensive agriculture and altered land-use patterns without necessarily enhancing local development (Kharel et al., 2023) [6]. Moreover, studies in sparsely populated areas reveal that urban-centric growth often fails to produce beneficial spillovers for rural hinterlands, instead exacerbating disconnects and deepening regional inequalities (Cristina, 2012 [7]; Chen and Hanori, 2009 [8]; Carson et al., 2022 [9]).

This ongoing debate within scholarly literature underscores the multifaceted nature of rural–urban migration's impact on regional development. The divergence in viewpoints highlights the need for comprehensive empirical analyses and nuanced investigations to better understand the complex dynamics involved in the interplay between migration, remittances, and their consequences for rural communities. Such research endeavours are essential for crafting effective policies that can harness the potential benefits of migration while addressing its challenges in the context of regional development.

Much research has explored the intricate correlation between non-agricultural employment and land efficiency. However, there has yet to be a consensus regarding this relationship's outcomes, with findings exhibiting considerable variation. Some empirical investigations suggest that non-agricultural employment negatively influences land productivity. For instance, Li et al. (2020) [10], drawing on survey data from the Loess Plateau in China, identified a significant increase in household income attributable to non-agricultural employment but also observed a notable decrease in agricultural labour productivity and land output associated with this form of employment. Similarly, Jiang et al. (2022) [11] corroborated these findings by demonstrating that non-agricultural employment poses constraints on agricultural production, particularly for smallholder households with fewer than three labourers, thereby hindering improvements in production efficiency.

In contrast, some studies posit a positive correlation between non-agricultural employment and the enhancement of land productivity. For example, Seoge and Zahonogo (2023) [12], analysing nationally representative data from Burkina Faso, identified non-agricultural activities as a significant determinant in elevating land production efficiency. Additionally, Nguyen et al. (2019) [13], examining non-agricultural employment behaviours in Vietnamese rural households, reported increased land productivity among rural households engaged in non-agricultural employment and receiving remittances.

Moreover, certain studies indicate that non-agricultural employment may not necessarily induce significant changes in land productivity. For instance, Sun's study (2021) [14] on land efficiency at the county level in China revealed that non-agricultural employment did not have a discernible impact on land efficiency in western Chinese counties.

The existing body of research presents conflicting views regarding land transfer and its relationship with land efficiency. Land transfer can contribute to improvements in land productivity. For instance, Ricker-Gilbert (2018) [15] identified significant positive effects of land transfer on household land productivity. Similarly, based on data from Ethiopia, Gottlieb and Grobovsek (2019) [16] found that land transfer could release surplus labour from agriculture, leading to increased rural–urban migration and ultimately resulting in improved agricultural productivity. Additionally, Kijima and Tabetando (2020) [17] found that land rental markets in Uganda and Kenya exhibited high efficiency, transitioning land from lower-capacity farming households to higher agricultural productivity, thereby enhancing overall agricultural production efficiency.

However, various pieces of literature have demonstrated negative relationships between land transfer and productivity. For instance, Pender and Fafchamps (2006) [18] compared land productivity between Africa's self-owned and rented land, revealing that the latter was less productive than the former. Chen et al. (2011) [19] used the DEA method to calculate the impact of land transfer on household productivity in Beijing, Shanghai, and Guangdong provinces. The results showed that land transfer could decrease land productivity.

In addition, there are also findings suggesting that land transfer does not necessarily lead to increased land efficiency (Gollin & Udry, 2021) [20]. Gai et al. (2020) [21], drawing upon data collected from established observation points in rural China, conducted a study illuminating how land transfers from households to corporations and cooperatives often find application in 'non-agricultural' and 'non-grain' ventures. Even with the overall rise in farmers' income after the transfer, there may be an equal enhancement in agricultural productivity. Similarly, Zhang et al. (2017) [22], utilising data from four counties in Jiangsu Province, ascertained that autonomously instigated household land transfers typically encompass relatively modest land scales and abbreviated transfer durations. This prevailing scenario militates against the facilitation of economies of scale and the realisation of enduring investments in production.

Consequently, impromptu land transfers might not exert a pronounced impact on agricultural productivity. The diverse findings in these studies underscore the complexity of the relationship between land transfer and land efficiency. Further research and nuanced analysis are needed to elucidate the underlying mechanisms and contextual factors contributing to the observed outcome variations. Such endeavours are crucial for informing policies and interventions to optimise land use and agricultural productivity in diverse regional contexts.

The existing literature on non-agricultural employment, land transfer, and land efficiency offers valuable insights but also presents several limitations that this study aims to address. Generally, research has predominantly focused on the economic outcomes of land transfer, such as income changes, often neglecting the broader concept of land efficiency, which encompasses the output value per unit of land area and sustainable land-use practices. Moreover, while previous studies have explored the direct effects of non-agricultural employment on rural economies, more comprehensive models that integrate these employment shifts with land-transfer behaviours and land-efficiency outcomes need to be

developed. This gap hinders a holistic understanding of how labour shifts away from agriculture influence land management and efficiency in the long term. Additionally, much of the existing research needs to sufficiently account for regional variations and the nuanced ways in which local policies, such as China's Three Rights Separation Reform, reshape land tenure and labour migration. Our study addresses these shortcomings by incorporating a nuanced econometric analysis that considers various forms of land transfer and their impacts on land efficiency. It provides a more detailed and context-sensitive understanding of these complex relationships.

This study contributes to existing literature in three aspects. Firstly, the paper focuses on the modes of land transfer and its impact on land efficiency after the Three Rights Separation Reform (TRSR) in China. Following the household responsibility system (HRS), the Chinese government introduced a key institutional innovation called the "Three Rights Separation Reform" in 2014. The TRSR, while retaining farmers' land contract rights, allows them to transfer management rights through land leasing, mortgage loans, or equity investment (Liu et al., 2017) [23]. This reform fundamentally reshapes land-tenure security, land-transfer modes, and labour migration. However, research on whether and how the TRSR triggers rural land transfer and utilisation is still limited. Our paper addresses this gap by carefully examining the interactions between non-agricultural employment, land transfer, and land efficiency four years after the implementation of the TRSR, filling the void in existing research.

Secondly, this study focuses on the key variable of land efficiency. Previous literature primarily explores the impact of non-agricultural employment and land transfer on agricultural production and yield, with limited attention to the variable of land efficiency. Land efficiency is crucial for national agricultural capacity and food self-sufficiency, and our study uniquely addresses this gap.

Thirdly, this study thoroughly explores the complex connections and mediating mechanisms between non-agricultural employment, land transfer, and land efficiency. Based on survey data collected in China, we incorporate non-agricultural employment, land transfer, and land efficiency into one econometric model and further explore land transfer by distinguishing between inflow and outflow modes. In addition to the baseline model, we investigate the mediating mechanisms through which land transfer affects land efficiency. Furthermore, we examine the heterogeneous effects among different groups based on factors such as age, gender, and technical guidance. As a result, our study provides a comprehensive empirical analysis of the intricate relationships between non-agricultural employment, land transfer, and land efficiency. This research offers policymakers in China and similar development environments valuable insights.

Section 2 above examines essential theoretical frameworks and the upcoming sections are arranged as follows. Section 3 provides background information and data details. Section 4 discusses empirical methodologies. Section 5 demonstrates this research's empirical results, and Section 6 discusses the findings and policy implications; finally, Section 7 provides concluding remarks.

3. Theoretical Analysis

Agricultural productivity is a multidimensional and comprehensive concept, encompassing land efficiency, labour productivity, cost–profit ratio, total factor productivity, and technological efficiency, among others (Fuglie, 2018) [24]. Given the relevance of land efficiency to agricultural production and food self-sufficiency, this paper employs land efficiency as a measure of agricultural productivity and presents the following theoretical framework.

H1. *Non-agricultural employment has a negative impact on land efficiency.*

Drawing on the existing literature, non-agricultural employment influences land efficiency through at least three pathways (Figure 1):

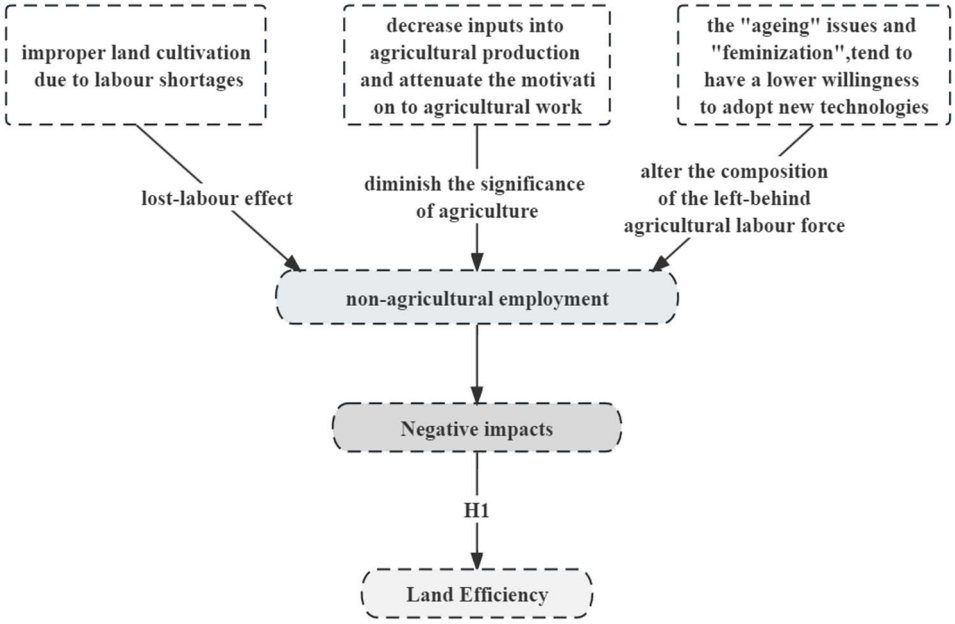

Figure 1. Theoretical mechanism for non-agricultural employment affecting land efficiency.

Firstly, non-agricultural employment can diminish land efficiency through the effect of labour lost. China's agriculture has long been characterised by a state of "overpopulation" and serves as a quintessential example of "involutionary" agriculture (Zongzhi Huang, 2020) [25]. To sustain their livelihoods, rural households often rely on investing more labour to increase output, often disregarding the opportunity costs of labour inputs. With the rapid economic development in China and the increasing availability of non-agricultural employment opportunities, a continually increasing number of surplus rural labourers have migrated to urban areas over the past four decades, leading to a reduction of nearly 300 million agricultural labourers. This excessive loss of agricultural labour can result in improper land cultivation due to labour shortages, leading to decreased land efficiency (Gathala et al., 2021) [26].

Secondly, non-agricultural employment can reduce land efficiency by diminishing the significance of agriculture in rural household economies. As the importance of agriculture diminishes, households may decrease their inputs into agricultural production. Non-agricultural income could gradually shift towards diversification or even part-time engagement in agriculture (Bai et al., 2022) [27]. Additionally, the rise in non-agricultural income could potentially decrease the labour effort of family members left behind by elevating the reservation wage and lowering the opportunity cost of leisure (Naiditch & Vranceanu, 2009) [28].

Thirdly, non-agricultural employment reduces land productivity by altering the composition of the left-behind agricultural labour force. In agricultural production, the land efficiency of the young and middle-aged population is relatively higher. The challenges related to "ageing" and the impacts associated with a more excellent representation of women in the labour force due to workforce outflows influence agricultural productivity outcomes (Roth et al., 2022) [29]. Elderly individuals, due to health conditions and declining physical strength, as well as limitations in their cultural qualifications, tend to reduce human capital and restrain agricultural scale management and technology progress (Zhang et. al., 2023) [30]. The feminisation of agriculture can reduce agricultural productivity due to the lack of resources (Yan et. al., 2022) [31] and opportunities available to women farmers (Kelkar, 2009) [32].

H2. *Land transfer positively affects land productivity.*

Land is a crucial element in agricultural production. Land transfer influences household land efficiency through the following pathways (Figure 2).

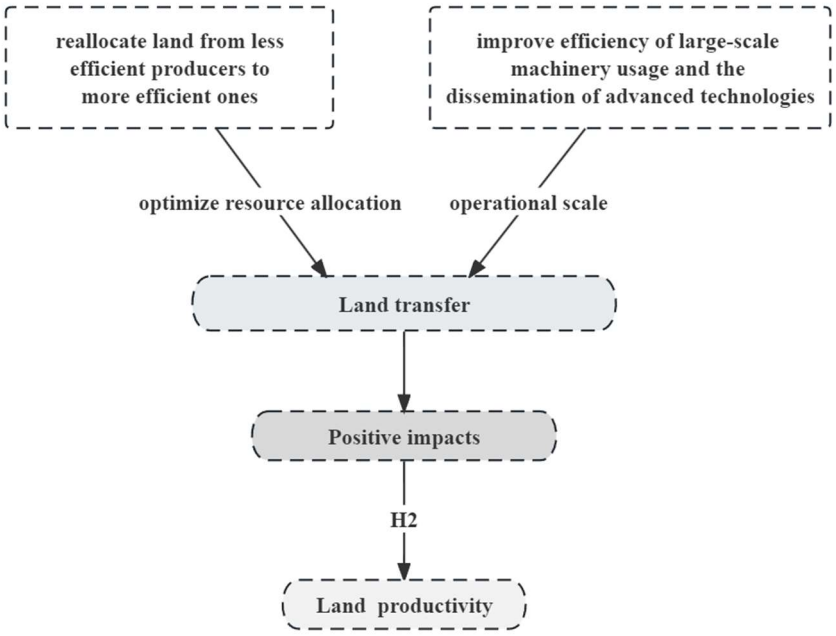

Figure 2. Theoretical mechanism for land transfer affecting land productivity.

Land transfer enhances land efficiency through optimised resource allocation. Some studies suggest that the establishment of land markets and the unrestricted flow of land transfers can lead to a "levelling effect" by reallocating land from less efficient producers to more efficient ones, thereby equalising the marginal output among households (Carter and Yao, 2002) [33] and consequently increasing land efficiency. Scholars also point out that the transfer of rural land contractual management rights can accelerate the process of agricultural land scaling and intensification (Deng et al., 2022) [34], facilitating the redistribution of capital and labour resources and ultimately enhancing productivity (Cao et al., 2007) [35].

Land transfer enhances land efficiency through the operational scale. Multiple research findings indicate that land transfer results in an expansion of the land operating scale. Most studies confirm a 'positive relationship' between land transfer and land productivity, emphasising the enlargement of the land operating scale (Alfaro et al., 2008 [36]; Adamopoulos and Restuccia, 2014 [37]). The primary mechanism is that the development of agricultural scale is a prerequisite for achieving agglomeration effects within agricultural industries, thereby positively impacting transaction efficiency and production efficiency. Additionally, compared to small-scale farmers, large-scale farmers possess a greater resilience against natural disasters, further contributing to an increase in efficiency (Zhou et al., 2020) [38]. The transfer of land might achieve the concentration of agricultural (Neguyen 1996) [39] and enable producers to adjust the production scale to achieve a certain scale effect, thereby improving the economies of scale.

H3. *Land plot size plays a mediating role in the effect of land inflow on land efficiency.*

H3a. *Land inflow has a positive impact on land plot size.*

H3b. *Land plot size has a positive impact on land efficiency.*

Land transfer improves land efficiency by alleviating land fragmentation. Land fragmentation, determined by the number of plots and the amount of land, can be detrimental in agricultural production (Hartvigsen, 2014) [40]. Land transfer, especially land inflow, is

expected to increase the average plot size and reduce land fragmentation, thereby enhancing land efficiency. Firstly, larger plot sizes enable farmers to distribute fixed costs (such as purchasing and maintaining machinery) more effectively (MacDonald, Korb and Hoppe, 2013) [41]. This reduces the cost per unit of output, thereby increasing the production efficiency (Roesch-McNally et al., 2017) [42]. Secondly, the increase in plot size allows farmers to utilise advanced agricultural machinery and techniques, which are often uneconomical or impracticable in small-scale production. Mechanisation significantly improves operational efficiency and precision, reduces the demand for labour, and enhances land output (Goyal and Singh, 2020 [43]; Javaid et al., 2022) [44]. Thirdly, larger plot sizes enable farmers to implement crop rotation and planting strategies more effectively; this can therefore improve soil quality, reduces pest and disease incidence, and thus enhances long-term land efficiency (Shah et al., 2021) [45]. Lastly, farmers can organise labour more efficiently on larger parcels, reducing the time and cost associated with transferring labour between parcels, thereby increasing productivity (Roesch-McNally et al., 2017) [42].

4. Data Description

China is experiencing the most significant rural–urban labour migration in its history, with an annual growth rate of 1% over the past four decades. This ongoing labour outmigration phenomenon has exerted profound and far-reaching influences on land utilisation patterns and rural communities in China, offering a valuable opportunity to investigate the implications of non-agricultural employment and land transfers on land efficiency.

The survey took place in 2019 in Zhejiang Province, China. Zhejiang Province is located in the south-eastern coastal area of China and is part of the renowned "Yangtze River Delta." The province has a land area of 105,500 square kilometres. As of 2023, the province's population is 66.27 million, with the service industry dominating the economy. The per capita GDP is 125,000 CNY/person, ranking fourth in China. We select Zhejiang Province as the research area for several reasons. Firstly, the province's level of agricultural modernisation ranks among the top in China. Secondly, rural–urban labour transfer is widespread here. Thirdly, there is a diversity of land-transfer behaviours and active innovation in land-management methods. Specifically, in terms of agricultural machinery and equipment, the comprehensive mechanisation level of crop cultivation and harvesting reached 74.9% in the province in 2021, ranking at the forefront nationwide. Regarding labour force transfer, Zhejiang Province has a high level of urbanisation, with an urbanisation rate reaching 73.4% in 2022, far exceeding the national average of 65.22%. The labour force transfer is active, and employment forms are diverse. In terms of land transfer, Zhejiang Province has a developed land-transfer market, with a large area of land under transfer and diverse transfer entities and forms. As of June 2020, the area of land transferred through leasing, shareholding cooperation, and other means in the province reached 11.2 million mu, with a land-transfer rate of 61.4%. In terms of innovation in land-management methods, Zhejiang is a pilot area for professional cooperatives. The number of new agricultural entities such as various agricultural enterprises, shareholding cooperatives, and family farms has rapidly increased.

The subjects of the survey were agricultural practitioners and migrant workers residing in rural areas. Agricultural practitioners include not only small-scale farmers but also individuals from larger farms, cooperative members, and employees of agricultural enterprises. We employed a stratified random sampling method for the selection of both the study area and interview participants. Initially, we categorised the regions into northern, central, and southern areas, considering the distribution of the agricultural population. Subsequently, we selected five counties—Yuyao, Yinzhou, Xiangshan, Ninghai, and Cixi—to represent these different geographical regions within the three areas, each of which possesses unique characteristics in agricultural development. Within these selected counties, we employed random sampling to choose 2 villages from each, resulting in 10 villages. Finally, we randomly selected 30 rural households from each village for our questionnaire-based interviews.

The questionnaire survey was carried out through face-to-face interviews and encompassed various aspects. It collected information of four parts: First, personal and family basic information, including family composition, age, education level, family income structure, expenditure, and employment details. Second, the land management and transfer of the subjects' households, including crop varieties, area, output value, production costs such as machinery, labour, land, fertilisers, pesticides, and hired labour, as well as land-transfer behaviour, area, method, amount, parties involved, and conflicts of interest. Third, social aspects of the subjects' lives, including housing, healthcare, network, employment, training, etc. Fourth, the terrain, location, and economic development of the surveyed villages. The questionnaire includes fill-in-the-blank, single-choice, multiple-choice, and scale questions. The Likert scale method is used for subjective judgment questions. A total of 300 questionnaires were collected. After carefully reviewing and eliminating questionnaires with incomplete or missing data, 274 valid questionnaires were retained (Table 1), resulting in a questionnaire validity rate of 91.3%.

Table 1. Distribution of survey areas.

Province/City	City/County	No. of Townships	No. of Valid Questionnaires
Zhejiang Province Ningbo City	Yuyao City	2	54
	Yinzhou District	2	56
	Xiangshan County	2	55
	Ninghai County	2	54
	Cixi City	2	55
Total	5	10	274

5. Empirical Strategy

5.1. Econometric Specification

Following the empirical methods of Li et al. (2010) [46] and Feng et al. (2010) [47], this paper establishes the baseline model as follows:

$$Y = C_i + \alpha_1 N + \alpha_2 Ti + \alpha_3 To + \sum \delta_i X_i + \varepsilon_i \quad (1)$$

Furthermore, we draw upon the approach of Jiang (2022) [48] and construct the following model to test the mediating mechanism by which land transfer affects land efficiency:

$$Mid_i = \beta_0 + \beta_1 Ti + \beta_2 X_i + C_i + \varepsilon_i \quad (2)$$

$$Y = \varphi_0 + \varphi_1 Ti + \varphi_2 Mid_i + \varphi_3 X_i + C_i + \varepsilon_i \quad (3)$$

where Y represents the land efficiency; N represents the non-agricultural employment of the households; Ti and To denote land inflow and land outflow, respectively; X_i represents a set of control variables (as indicated in Table 2); Mid_i represents the mediating variable, that is, the average land plot size; and ε_i is the error term.

Following the theoretical model presented in the second section of this paper and drawing on relevant existing literature, the following variables are introduced:

The variable Y represents land efficiency, measured as RMB per mu of agricultural profit in 2018. Land efficiency holds substantial significance in the context of agricultural capacity and, by extension, plays a crucial role in influencing food self-sufficiency within China (Qian and Hong, 2016) [49]. However, exploring its relationship with non-agricultural employment and land transfer has been relatively underexplored in the existing literature. Land efficiency, as quantified here, is calculated as the annual profit per unit of land area (mu). It is calculated by deducting the cultivation costs, encompassing expenses like seed costs, applied fertilisers, and land rent, from the total market value of the produce categorised by crop type.

Non-agricultural employment, represented by the variable N is the proportion of non-agricultural labour to the total household labour force. This definition is drawn from Kung's research conducted in 2002 (Kung, 2002) [50]. Non-agricultural labour refers to individuals

who migrate to urban regions and participate in non-agricultural industries for six months. This variable provides a means to quantify the extent to which households allocate their labour resources between agricultural and non-agricultural sectors, a dimension that holds relevance in understanding the dynamics of land efficiency and its association with workforce migration and land transfer.

Table 2. Descriptive statistics (N = 274).

Variable	Definition	Mean	Std. Dev.	Min. Level	Max. Level
Land efficiency	Annual profit per mu of land in 2018 (yuan per mu, log value)	3.34	0.33	2.68	4.40
Non-agricultural employment	The ratio of non-agricultural labour to total household labour (%)	49.85	31.59	0	100
Ti	Land transfer—in, dummy variable (1 = The household transfer-in land)	0.25	0.43	0	1
To	Land transfer—out, dummy variable (1 = The household transfer-out land)	0.20	0.40	0	1
Labour input	The ratio of the number of agricultural laborers to actual cultivated land scale (person per mu, log value).	−0.44	0.55	−2.66	0.78
Plot size	The ratio of the total land scale at the end of the year per household to the total numbers of plots (mu)	11.31	65.44	0.20	926.00
Machinery	Annual expenditure on machinery (CNY, log value)	2.43	1.34	0	5.62
Gender of household head	Gender of the household head (1 = male)	0.86	0.34	0	1
Age of household head	Age of the household head	55.28	10.35	31	61
Education of household head	Schooling years of the household head	7.87	2.30	5	14.5
Agricultural training	Count of family members who received the agricultural training	1.71	0.46	0	3
Family average age	Average age of the family	46.82	11.25	22.25	64.50
Proportion of female adults in the household	Share of female adults in household (%)	0.49	0.14	0	1
Family education	Average years of schooling for family members	8.52	1.98	5.00	18.10
Village economy	Annual income of the village (10,000 CNY)	4.04	0.20	3.66	4.65
Village transportation	The time it takes to drive to the county centre (hour)	0.81	0.30	0.25	1.40

Ti and T_O estimate the variable of land transfer. However, the analysis of land-transfer behaviour cannot focus solely on whether households are engaged in land transfer; it also necessitates examining whether farmers participate in land inflow or outflow. This study employs dummy variables such as 'participation in land outflow' (To) or 'participation in land inflow' (Ti) to provide a more precise measurement of their land-transfer behaviours (Feng et al., 2010) [47].

Plot size is quantified by the ratio of the total land scale at the end of the year per household to the total numbers of plots, which reflects the extent of land fragmentation. Land fragmentation can be attributed to China's resource endowment of high population density and limited land resources, with the per capita arable land area being only about one-third of the world average (Wu et al., 2015) [51]. It affects land efficiency by influencing the allocation of other agricultural inputs. Land fragmentation refers to a household's land resources being divided into multiple spatially separated plots (Mcpherson, 1983) [52].

Xi incorporates a comprehensive set of control variables at the individual, household, and village levels to elucidate the determinants of land efficiency. These variables encompass various agricultural production factors, including labour input and machinery. By accounting for these multifaceted characteristics and factors, the analysis aims to provide a more robust and nuanced understanding of the factors influencing land efficiency within the study context. Following existing literature, machinery input is represented by the cost of renting agricultural machinery or the annual depreciation cost of owned agricultural machinery for households (log value).

Moreover, one anticipates that the gender, age, and educational attainment of the household head, along with the demographic attributes and educational backgrounds of other family members, are likely to influence this context.

Household Head Characteristics. The household head typically plays a pivotal role in agricultural production decisions. This study defines the 'household head' as the 'person responsible for managing agricultural accounts.' The gender, age, and educational years of the household head influence agricultural production. A substantial body of literature demonstrates that education and other forms of human capital yield significant benefits in crop production (Jamison and Lau, 1983 [53]; Taylor and Martin, 2001 [54]). In the model, we incorporate three variables for control: Gender of the household head, age of the household head, and educational level of the household head.

Family Characteristics. Household decisions in agriculture often involve joint decisions at the family level (Stark, 1991) [55]. Therefore, the human capital characteristics of the household significantly impact decision-making processes. When assessing the influence of non-agricultural employment on labour loss in agricultural production, it becomes imperative to gauge the productivity of the remaining population. The 'ageing' effect resulting from labour outflow and the 'feminisation' effect may contribute to shaping agricultural productivity (Szabo et al., 2021 [56]; Shweta, 2023 [57]).

Consequently, we consider four variables as indicators of household human capital characteristics: Family education (average education level of family members), family average age, proportion of female adults within the household, and number of individuals receiving agricultural skills training (agricultural training). In alignment with the methodology utilised by the National Bureau of Statistics, family education is calculated using the following formula: Family education = (P1 × 6 + P2 × 9 + P3 × 12 + P4 × 16)/P. Here, Pi represents the number of family members with educational attainment at the primary, middle, high school, or university and above levels. At the same time, P denotes the total count of family members aged six years and older.

Village Characteristics. Previous studies in relevant contexts have seldom considered the influence of village-level factors. However, village characteristics are likely to impact household land efficiency. Therefore, this study incorporates the village's economy and transportation conditions as control variables. The village's economy is assessed using the operational income (in 10k Chinese yuan renminbi/CNY) of the village in 2018. Village transportation is measured by the time (in hours) required to drive to the nearest county centre from the village.

County. Substantial variations in land efficiency exist across diverse regions. The study incorporates county dummy variables (county) to account for this factor. Explanations and descriptive statistics are presented in Table 2.

5.2. Endogeneity

Endogeneity issues may exist among non-agricultural employment, land transfer, and land efficiency. Firstly, non-agricultural employment could influence land transfer. The higher the proportion of non-agricultural employment among household labour, the more likely farmers are to engage in land transfer. Numerous studies confirm that non-agricultural employment effectively stimulates the development of the land-transfer market (Kung, 2002) [50]. Secondly, land transfer can also affect household labour allocation decisions. Farm households involved in land transfer are more likely to have more agricultural labour, potentially leading to a relatively smaller proportion of non-agricultural employment. Simultaneously, if the local land-transfer market is conducive to farmers transferring out the land, the willingness for non-agricultural employment in that region might be higher. Thirdly, potential sample selection bias and reverse causality issues should be considered. To elaborate, households with non-agricultural workers may exhibit a greater land efficiency than those without such workers, as individuals with the highest agricultural efficiency may transition to non-agricultural sectors to access higher income opportunities. Conversely, there may be a counteracting bias suggesting that households with non-agricultural workers are inherently less productive. Therefore, we can only better analyse the impact of non-agricultural employment and land transfer on household land efficiency by effectively addressing endogeneity issues.

6. Research Results

The regression results are presented in Table 3. The effect of non-agricultural employment on land efficiency is positive, although not statistically significant. This implies that the mechanism and direction of the effect of non-agricultural employment on land efficiency are intricate. Amidst the interplay of negative and positive impacts, distinct circumstances can result in diverse effects on land efficiency.

Table 3. Regression results for land efficiency (N = 274).

	Land Efficiency			
	(1)	**(2)**	**(3)**	**(4)**
Non-agricultural employment	0.000122	7.70×10^{-5}	0.000104	0.000106
	(0.000369)	(0.000394)	(0.000411)	(0.000401)
Ti	0.155 ***	0.148 ***	0.151 ***	0.100 **
	(0.0451)	(0.0475)	(0.0489)	(0.0427)
To	−0.00392	−0.00453	−0.00304	−0.00851
	(0.0341)	(0.0349)	(0.0350)	(0.0331)
Labour input	0.184 ***	0.185 ***	0.184 ***	0.204 ***
	(0.0374)	(0.0376)	(0.0393)	(0.0351)
Machinery		−0.000535	−0.00121	−0.00149
		(0.00143)	(0.00143)	(0.00140)
Gender of household head		0.00336	−0.000591	−0.000411
		(0.00513)	(0.00573)	(0.00521)
Age of household head		−0.0118	−0.0104	−0.00725
		(0.0270)	(0.0276)	(0.0268)
Education of household head			0.00177	0.00185
			(0.00134)	(0.00136)
Agricultural training			0.0109	0.0466
			(0.0906)	(0.0886)
Family average age			0.00828	0.00634
			(0.00784)	(0.00718)
Proportion of female adults in the household				0.381 ***
				(0.0791)
Family education				0.134
				(0.0886)
Village economy	3.291 ***	3.312 ***	3.213 ***	1.626 ***
	(0.0355)	(0.118)	(0.158)	(0.362)
Village transportation	0.000122	7.70×10^{-5}	0.000104	0.000106
	(0.000369)	(0.000394)	(0.000411)	(0.000401)
County	0.155 ***	0.148 ***	0.151 ***	0.100 **
Constant	(0.0451)	(0.0475)	(0.0489)	(0.0427)
	−0.00392	−0.00453	−0.00304	−0.00851

Note: *** and ** show significance levels at 1% and 5%.

The negative impact of non-agricultural employment on agricultural production is discernibly manifested in what can be termed the "labour loss effect." This effect reflects the outcome of non-agricultural employment, contributing to negligence in agricultural production and a reduction in family labour input, thereby adversely influencing land productivity (Maharjan et al., 2013) [58]. Non-agricultural employment often results in migrating educated and technically skilled young adults from rural agricultural labour to non-agricultural sectors (Uprety, 2019) [59]. Consequently, this migration reduces the profitability of agricultural land production, ultimately resulting in a decline in land productivity.

Simultaneously, as an indirect investment, non-agricultural employment serves as a source of income for rural households while mitigating agricultural production risks (Stark, 1982) [60]. Firstly, non-agricultural employment generates a positive compensatory effect. The increase in non-agricultural income for rural households alleviates financial and credit constraints that might impede their engagement in agricultural production activities

(Kirimi and Kirimi, 2006) [61]. It also stimulates rural households to invest in agricultural productive assets, technology, and agricultural social services (Li et al., 2013 [62]; Jiang, 2022 [11]), thereby enhancing land productivity. Secondly, non-agricultural employment enhances land productivity through risk-reduction mechanisms. By diversifying income sources, non-agricultural income acts as an informal insurance system, enabling rural households to self-finance their agricultural production endeavours and providing a safety net against potential income risks (Lucas, 1987 [63]; Stark, 1982 [60]). In a more specific context, non-agricultural income functions as a mechanism for rural households to manage fluctuations in agricultural product prices and production. This, in turn, enables the transition to agricultural production patterns that support heightened land productivity (Damon, 2010) [64]. Furthermore, non-agricultural employment enhances rural households' capacity to access information. It improves their risk preferences, encouraging risk-averse rural households to participate in high-yield but uncertain investments (Wouterse, 2010) [65].

In summary, the impact of non-agricultural employment on land productivity is multifaceted, with both negative and positive dimensions. While the "labour loss effect" is a notable negative consequence, the positive effects include the compensatory and risk-reducing mechanisms associated with non-agricultural income, which can lead to increased land productivity. The intricate interplay between these factors underscores the complexity of the relationship between non-agricultural employment and land efficiency, necessitating further research and analysis to discern the contextual nuances and policy implications.

Land inflow significantly and positively affects land efficiency, whereas the influence of land outflow on land efficiency does not demonstrate statistical significance. The inflow of land significantly contributes to the enhancement of land efficiency, which aligns with the findings of Hongzhong Fan and Qiliang Zhou (2014) [66]. It is possibly attributed to the allocation of land to the households with a comparative advantage in agricultural production. Upon acquiring land, these households can make more investments on a more concentrated scale; this, in turn, leads to a heightened production technology and management proficiency, optimisation of land-utilisation methods, and the realisation of economies of scale, thus resulting in an elevation in land efficiency (Wang et al., 2011 [67]; Qian et al., 2014 [49]).

Conversely, the impact of land outflow did not yield statistically significant results, implying that land outflow has a limited influence on land efficiency; this could be attributed to the fact that transferring out their land, farmers do not necessarily employ more advanced agricultural machinery and equipment, while the land and labour quality remain the same. Consequently, the configuration and quality of production factors remain akin to the pre-transfer state, thereby causing the lack of a notable influence on land efficiency following land outflow (Chen et al., 2011 [19]). Concerning the control variables, notable factors include three variables: labour input, machinery, and the village economy.

More specifically, the labour input exhibits a positive influence on the land efficiency, in line with the prevailing consensus in the literature (Cheng et al., 2019) [68] that a heightened agricultural labour input can bolster land efficiency. This also indicates that Chinese households are typical small-scale producers who rationally increase labour input per unit of land to boost land efficiency, even though this is achieved at the cost of sacrificing labour productivity (Huang, 2020) [25].

Machinery demonstrates a significant effect on land efficiency. The literature consistently demonstrates a positive impact of machinery on land efficiency, underscoring the pivotal role of mechanisation in augmenting land productivity (Bekchanov et al., 2021) [69]. Agricultural mechanisation brings several noteworthy advantages, including reducing labour-intensive tasks, alleviating labour shortages, and improving productivity and timeliness in various agricultural operations. As mechanisation continues to advance, it leads to the intensified substitution of capital and new technology for labour (Olasehinde-Williams et al., 2020 [70]; Mdoda et al., 2022 [71]). This transition underscores the growing importance of machinery in agricultural processes, particularly in mitigating the dependence on labour-intensive practices. Moreover, adopting advanced machinery further contributes to

the augmentation of land productivity (Damba et al., 2020 [72]). This outcome underscores the transformative impact that modern agricultural machinery can have on agricultural practices, ultimately resulting in increased efficiency and productivity in land use (Ignatov et al., 2020) [73].

The village's economy significantly and positively influences the land efficiency, underscoring that the economic prowess of villages and collective economy entities positively impacts land efficiency. In locales characterised by heightened village economic development and a robust economic basis, collective economic organisations possess an increased capacity to construct rural public infrastructure and provide public services. Such areas typically boast well-established, advanced infrastructure, including robust road networks and water facilities. When coupled, irrigation systems and rural roads demonstrate complementary effects on labour while offering substitutive effects on fixed capital. This infrastructure can effectively curtail agricultural production costs, significantly enhancing land productivity (Shamdasani, 2021) [74].

This study further tests the land plot size's mediating role in the effect of land inflow on land efficiency. Column (1) of Table 4 shows that the coefficient for Ti is significantly positive, indicating that land transfer can significantly increase the average land plot size for farmers, allowing for improved rational planting decisions. Column (2) shows that the Ti and plot size coefficients are significantly positive, suggesting that land transfer enhances land efficiency by increasing the average plot size. Thus, it demonstrates the mediating effect of the average land plot size, supporting Hypothesis H3.

Table 4. Test results of the mediating effect.

Variables	Plot Size (1)	Land Efficiency (2)
Ti	5.295 *	0.0916 **
	(3.098)	(0.0427)
Land scale		0.00161 *
		(0.000975)
Controls	ALL	ALL
County fixed	YES	YES
Constant	−49.23	1.705 ***
	(55.81)	(0.329)

Note: ***, **, and * show the significance level at 1%, 5%, and 10%.

6.1. Heterogeneity Analysis

After testifying to the positive impact of land transfer on land efficiency, this study proceeds to conduct a heterogeneity analysis to identify the groups of farmers who benefit the most and the least from land transfer. This section will examine the heterogeneous impacts of land transfer on land efficiency across farmer groups, categorised by age, gender, and technical guidance. It aims to provide a reliable basis for implementing policies to enhance land efficiency and farmers' welfare.

6.2. Heterogeneity across Age Groups

There are significant differences in the education and intentions embraced by farmers of different ages, leading to variations in decisions related to cultivation and technology adoption and ultimately affecting land efficiency. Therefore, this study further examines the differences in land efficiency among farmers in different age groups after transferring in land. Based on the three age categories of the sampled farmers, they are classified as the new-generation farmers (below 51 years old), middle-generation farmers (51–60 years old), and the older-generation farmers (60 years and above). The study analyses the similarities and differences in the regression coefficients of each group.

Table 5 presents the heterogeneous impact on land efficiency after transferring in land for different age groups, as indicated by Columns (1), (2), and (3). The regression results indicate a significantly positive effect of transferring in land on land efficiency for both the

new-generation and middle-generation farmers, with a larger impact on the land efficiency of the middle-generation farmers. However, there is no significant impact on the land efficiency of the older-generation farmers. The new-generation and middle-generation farmers tend to have higher levels of education, making them more willing and able to adopt and apply new agricultural technologies, cultivation methods, or market information. This contributes to an improvement in land efficiency and crop quality. On the other hand, the older-generation farmers are often accustomed to traditional agricultural production methods and technologies, exhibiting lower levels of acceptance and application of new technologies and methods, thereby limiting the improvement of land efficiency.

Table 5. Heterogeneity analysis.

Variables	Age Group			Gender Group		Technical Guidance Group	
	New Generation (1)	Middle Generation (2)	Older Generation (3)	Male (4)	Female (5)	Provided (6)	Not Provided (7)
Ti	0.102 *	0.202 *	0.0402	0.0736 *	0.310	0.158 *	0.0659
	(0.0577)	(0.108)	(0.0670)	(0.0444)	(0.240)	(0.0797)	(0.0487)
Controls	ALL	ALL	ALL	ALL	ALL	ALL	ALL
County fixed	YES	YES	YES	YES	YES	YES	YES
Constant	1.573 **	1.572 *	1.760 ***	1.604 ***	2.190 **	3.489 ***	1.063 ***
	(0.596)	(0.832)	(0.507)	(0.393)	(1.005)	(0.726)	(0.396)
Observations	96	74	104	236	38	76	198
R^2	0.629	0.856	0.828	0.791	0.872	0.579	0.815

Note: ***, **, and * show the significance level at 1%, 5%, and 10%.

6.3. Heterogeneity across Gender Groups

Different gendered farmers bear distinct social and family role expectations, facing varied avenues of resource acquisition, development capabilities, and decision-making environments, thereby influencing land efficiency. Consequently, this study further examines the differences in land efficiency among farmers of different genders after transferring in land. Based on the gender characteristics of the household head, farmers are categorised as male or female, and the similarities and differences in the regression coefficients of different gender characteristics are analysed.

In Table 5, Columns (4) and (5) report the heterogeneous impact on land efficiency after transferring in land for different gendered farmers. The regression results indicate that transferring in land has a significantly positive impact on land efficiency for male farmers, while it does not have a significant impact for female farmers. In traditional Chinese rural society, male farmers are typically regarded as the primary economic backbone of the family, more easily accessing new agricultural technologies, cultivation methods, and agricultural training. This contributes to the improvement of their production skills and land-management capabilities, ultimately enhancing land efficiency. Female farmers, due to certain levels of gender discrimination or traditional customs, may simultaneously bear the dual responsibilities of agricultural production and household care. This limits their time and energy investment in agricultural production, with fewer opportunities for agricultural training, ultimately restricting the improvement of land efficiency.

6.4. Heterogeneity across Technical Guidance Groups

After farmers transfer in land, whether they receive technical guidance plays a crucial role in enhancing land efficiency. Therefore, this study further examines the differences in land efficiency based on whether farmers receive technical guidance after transitioning to agriculture. This is defined based on the questionnaire question "Have you received technical guidance or field guidance during production?". Specifically, receiving technical guidance or field guidance is assigned a value of 1, while not receiving it is assigned a

value of 0. The study further analyses the similarities and differences in the regression coefficients of different technical guidance characteristics.

In Table 5, Columns (6) and (7) report the heterogeneous impact on land efficiency after farmers transfer in land based on whether technical guidance is provided. The regression results indicate that providing technical guidance or field guidance to farmers after transitioning to agriculture has a significantly positive impact on land efficiency, while not providing technical guidance does not have a significant impact. The government and agricultural-related departments mainly provide technical guidance to farmers who transfer in land. On the one hand, this can offer knowledge and skills in areas such as the latest agricultural practices, crop management, soil conservation, and water resource management, using more advanced scientific methods to improve land output. On the other hand, it can provide farmers with advice on aspects like market analysis and crop selection, helping them to plant crops that are marketable and in demand, thereby increasing land efficiency.

6.5. Robustness Test

The consideration of endogeneity in this study encompasses the potential issues of omitted variable bias and collinearity. Firstly, in terms of omitted variable bias, the model presented here incorporates variables such as labour input, machinery, household head characteristics, family characteristics, village characteristics, and county-level factors through a stepwise approach. As these variables are progressively included, the coefficients and significance of the crucial variables in the model remain relatively stable. This observation underscores the robustness of the regression results derived in this study and validates the rationality of the empirical specification. For future research, incorporating instrumental variables could further enrich the scope of the investigation.

To address collinearity concerns, this study computes the variance inflation factor (VIF) post-regression, as illustrated in Table 6. The highest VIF recorded is 3.33, notably below the threshold of 10. This finding signifies the absence of multicollinearity concerns among land transfer, non-farm employment, and the other primary variables.

Table 6. Variance inflation factor (VIF) values in the model.

Variable	VIF	1/VIF
Non-agricultural employment	1.37	0.73
Ti	2.41	0.42
To	1.43	0.70
Labour input	3.15	0.32
Land scale	3.33	0.30
Plot size	2.58	0.39
Machinery	1.53	0.66
Gender of household head	1.15	0.87
Age of household head	1.76	0.57
Education of household head	1.90	0.53
Agricultural training	1.25	0.80
Family average age	1.97	0.51
Proportion of female adults in the household	1.09	0.92
Family education	1.99	0.50
Village economy	1.48	0.67
Village transportation	2.50	0.40
Mean VIF	2.00	

7. Discussion

7.1. Main Findings

Firstly, the impact of non-farm employment on land efficiency in rural households is not statistically significant. This result is inconsistent with the findings of Nguyen et al.

(2021) [75]. This inconsistency may be due to the complex mechanisms through which non-agricultural employment affects land efficiency, involving both negative and positive impacts. The negative impact primarily arises from the labour-loss effect generated by rural–urban labour transfer, leading toa neglect of agricultural production, reduction in household labour, and decline in labour quality, ultimately resulting in a decrease in land efficiency. The positive impact mainly comes from the compensatory effect of non-agricultural income and risk-reduction effect (Uprety, 2019) [59]. Specifically, non-agricultural income in rural households can alleviate the credit constraints faced by agricultural production. Additionally, by diversifying their sources of income, it enhances the resilience of rural households against risks, facilitating them to make scientific and reasonable planting decisions, thereby improving land productivity (Damon, 2010 [64]). The intricate interplay between these negative and positive factors underscores the complexity of the relationship between non-agricultural employment and land efficiency, necessitating further research and analysis to discern the contextual nuances and policy implications.

Secondly, unlike previous studies, this paper subdivides land-transfer behaviour into land outflow and inflow. The empirical results indicate that land inflow can significantly increase land efficiency, while land outflow does not have a significant impact. Land inflow shows a significant positive effect on land efficiency, consistent with the findings of Chavas et al. (2022) [76]. This may be attributed to reallocating land to households with relative advantages in agricultural production. These households, after acquiring land, can operate at a moderate scale, which helps to improve production techniques and management skills, achieve economies of scale, and ultimately enhance land efficiency (Daymard, 2022) [77]. Conversely, land outflow does not significantly affect land productivity, possibly because farmers, after transferring land out, do not use more advanced agricultural machinery and equipment. Additionally, the land and labour quality remain unchanged, meaning that the configuration and quality of production factors remain similar to before the transfer, thus not significantly increasing land efficiency.

Thirdly, this paper employs a mediation model to empirically examine the mechanism through which land inflow affects land efficiency. The study finds that land inflow enhances land efficiency by reducing the degree of land fragmentation and increasing the average size of land plots. The plausible rationale behind this phenomenon is rooted in the fact that agricultural production necessitates labour input and the significant utilisation of machinery, chemical applications, biotechnological inputs, and the like. Farmers with smaller plots often experience the loss of agricultural inputs. Specifically, small plots reduce fixed asset efficiency and constrain the construction of farmland infrastructure, which is indivisible in agriculture. Due to increased boundaries and ridges between small and dispersed plots, irrigation efficiency falls. Agricultural operation time is wasted, leading to poor field management (Lu et al., 2018) [78]. Furthermore, the presence of small and dispersed land plots has a notable impact on the adoption of machinery and modern agricultural technologies, necessitating farmers to allocate additional resources in terms of labour, time, and psychological efforts (Wei, 2015) [79]. Conversely, following the inflow of land, the fragmentation level of land diminishes, increasing the plot size. This enlargement, in turn, stimulates the utilisation of production factors such as labour, technology, and machinery (Foster and Rosenzweig, 2022 [80]), reduces overall production costs, and improves technical efficiency (Orea et al., 2019 [81]).

7.2. Policy Implications

Firstly, the impact of non-farm employment on land efficiency in rural households remains uncertain. Given the substantial disparities in factors such as land endowment, industrialisation, and urbanisation across various rural areas in China, it becomes imperative to continue promoting agricultural labour migration while concurrently enhancing supporting measures. This approach will allow capable and motivated professional farmers to leverage their positive influence fully. Additionally, careful consideration must be given to the potential adverse effects of excessive labour migration on land utilisation. Employing

flexible strategies like demonstration and guidance can encourage resident farmers to adopt new agricultural machinery and production techniques, thereby enhancing land efficiency.

Secondly, as land transfer becomes more prevalent, the land efficiency of households who transfer out land remains mainly unaffected, while land inflow positively impacts increasing land output. Therefore, to enhance land efficiency, efforts should be focused on facilitating smooth land transfers, promoting the development and prosperity of rural land markets, and guiding land transfer towards new forms of agricultural operators, such as skilled farmers, family farms, and agricultural cooperatives. Measures must be taken to encourage land transfer and enhance allocative efficiency by equitably distributing land and labour resources among farmers with varying land–labour endowments.

Thirdly, land inflow contributes to the enhancement of land efficiency through the mediating mechanism of increased land plot sizes and reduced fragmentation. Therefore, while guiding the expansion of land scales, a greater emphasis should be placed on consolidating and reorganising fragmented land, creating substantial and well-managed parcels of arable land. This entails achieving concentrated and contiguous transferable land blocks, ensuring level plots and providing adequate supporting facilities. Simultaneously, proactive efforts should be undertaken to advance the construction of high-standard farmland, creating a favourable environmental foundation for intensive agricultural management and promoting the transformation and development of agriculture.

8. Conclusions

Rural–urban migration and land transfer play a crucial role in land utilisation and agricultural production in China. This study, based on data from 274 on-site surveys in Zhejiang Province, examines the impact mechanisms of non-agricultural employment and land transfer on land efficiency and provides a profound explanation of the underlying mechanisms. In contrast to previous research, our approach integrates non-agricultural employment and land transfer into one econometric model to comprehensively investigate their combined effects on land efficiency. Additionally, we carefully examine the diverse impacts under different land-transfer modes. The results indicate that the impact of non-agricultural employment on land efficiency is not significant, contrary to existing research findings. This complex outcome arises from the dual nature of its impact mechanisms, namely the negative effect of labour loss and the positive effect of remittances. The inflow of land significantly enhances land efficiency, while the outflow of land has an insignificant impact. Furthermore, this study demonstrates the mediating effect of land plot size in the impact of land inflow on land efficiency, providing additional insights into the mechanism. Moreover, we investigates the heterogeneous effects among different groups such as age, gender, and technical guidance in this process. Based on the conclusions, the following policy measures are explored.

Although our study offers insights into the effects and mediating mechanism of rural–urban labour transfer and land transfer on land efficiency, it has limitations that need to be addressed. Firstly, when rural–urban migrant workers find employment in other places, they no longer consume food at home. This may serve as another significant impetus for rural–urban labour transfer among impoverished rural households (Van der Geest, 2010) [82], directly impacting the agricultural productivity of the household (Shi et al., 2011) [83], but it is not included in the theoretical framework. Due to the lack of data on individual food consumption, we are unable to study this factor separately. Secondly, the empirical outcomes of this research indicate that non-agricultural employment has not demonstrated a statistically significant influence on land efficiency. This divergence from the findings of Taylor et al. (2003) [84] and Shi (2018) [85] highlights a potential inconsistency. It is plausible that this incongruity could stem from the study's omission of a differentiated and individualised examination of the diverse modes within the realm of non-agricultural employment. This paper provides a preliminary explanation of this issue but does not delve into detailed empirical analysis.

To address the above issues, future research should focus on detailed classification of non-agricultural employment, distinguishing between seasonal and long-term transitions. Through this approach, it is feasible to meticulously investigate the distinct pathways and orientations through which various migration modes impact land efficiency. To navigate this intricate landscape, prospective research endeavours may find merit in deconstructing the facet of non-agricultural employment into discrete categories of seasonal and long-term transitions. This nuanced approach could facilitate a meticulous examination of their divergent trajectories and the diverse impacts they impart on the intricate tapestry of land efficiency.

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